Euphausiid Length and Abundance in the Eastern Bering Sea

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Background

1. Euphausiids (krill), small shrimp-like zooplankton, are essential to the diets of many marine animals, seabirds, and fish.
2. Important economically as a significant prey species of walleye pollock, the largest commercial fishery in the U.S.
3. NOAA-MACE uses bio-acoustic technology and sampling data from surveys to assess walleye pollock stocks and euphausiid abundance.

←(Figure 1) Euphausiid underneath a microscope

(Figure 2) Walleye Pollock sorting

Goals

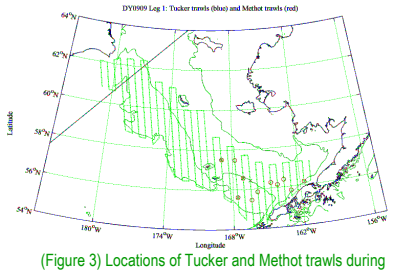
1. Assess relative euphausiid density near the surface, in the water column, and near the bottom of the eastern Bering Sea
2. Develop a procedure for measuring and identifying euphausiids while at sea during NOAA/MACE surveys.

Hypothesis

1. Abundance greatest in water column
2. Species ID and length measurements can be made at sea
3. Results of identification and measurement by microscope and scanner/image analysis software are equivalent

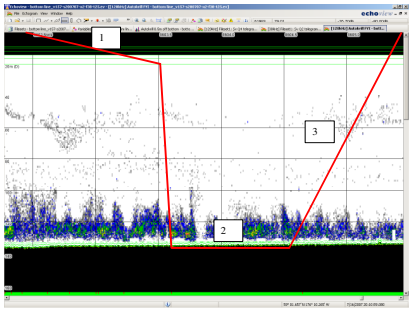
Sample Collection

All samples were collected during the first leg of MACE Summer Walleye Pollock Survey (cruise number DY0909) from June 8, 2009 to June 28, 2009 aboard the NOAA Ship Oscar Dyson in the Eastern Bering Sea. Samples were taken at the same time each day to compensate for daily euphausiid migration within the water column.



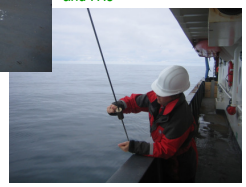
(Figure 3) Locations of Tucker and Methot trawls during DY0909 Leg 1

Sample Collection (continued)



(Figure 4) Tucker trawl fishing pattern

←(Figure 5) 0.500mm mesh net Tucker trawl with benthic skis, bottom contact sensor, and ITIs

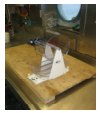


(Figure 6) ➔ Deployment of the copper messenger to open and close the Tucker nets between layers

Sample Processing

1. Weigh entire sample (Figure 7)
2. Pull out fish and jellyfish
3. Scoop/weigh subsample for Polish Plankton Sorting Center
4. Subsample euphausiid mix for at sea preservation and sorting
5. Split subsample for at sea processing into manageable size of euphausiids (50 to 100) using Folsom Plankton Splitter (Figure 8)
6. Pick out euphausiids for species ID and length (Figure 9)
7. Identify Species and measure using a microscope
8. Scan euphausiids on modified flatbed scanner and measure length using image analysis software

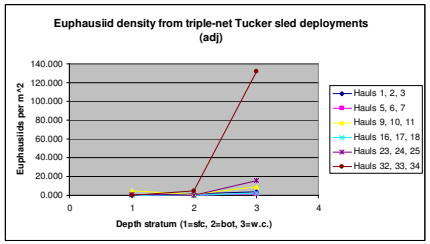
(Figure 7)



(Figure 8)

(Figure 9)

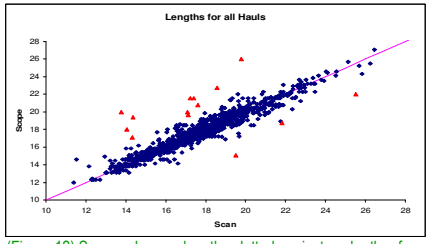
Euphausiid Abundance



(Figure 11) Integrated euphausiid density by depth adjusted for time spent in layer 2.

1. In all six Tucker trawl net samples, net three always contained the highest number of euphausiids as suspected.
2. Euphausiid abundance in surface and bottom layers averaged only 5-12% of abundance in rest of water column.
3. Non-parametric Friedman ANOVA

Euphausiid Length (Scope vs Image Analysis)

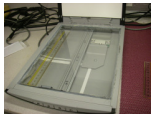


(Figure 12) Scan and scope lengths plotted against each other for comparison. Red triangles represent outliers.

1. Outliers explained by errors in measuring and deterioration of animals while being moved from scope to scanner.
2. A paired sample t-test was used to compare measurements made with the scanner and measurements used with the scope.
3. Without including the outliers: $t_{0.05}(1.9) > t\ (1.8)$ therefore, accept null (no significant difference between measurements).
4. The microscope is more reliable method for species ID because euphausiids can be manipulated under the microscope to see fine traits.

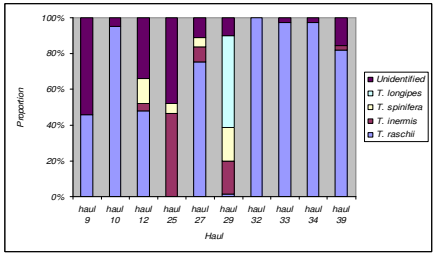
(Figure 13) Performing image analysis at sea

(Figure 14) ex. of a scan used for image analysis



(Figure 15) Scanner modifications: caulk and ruler

Species Composition



(Figure 16) Species composition for all hauls with > 30 euphausiids. This suggests that species distribution is patchy and variable, but in any given area one species will be more abundant than the others.

Note: Some hauls are at same location but different depths

Identifying Species Characteristics

Thysanoessa spinifera
Prominent spines on 4-6th abdominal segments

Thysanoessa longipes
Bilobed eye
Heavily modified leg
Denticle near carapice
Dorsal spines on 3-6th abdominal segments

Thysanoessa raschii
Denticle 1/3 way up carapice
No dorsal spines

Thysanoessa inermis
Dorsal spine on 6th (and sometimes 5th) abdominal segment

Suggested Future Research

1. Compare results with bioacoustic data for a more accurate estimate of euphausiid density
2. Collect more samples to reduce statistical variability
3. Solve net contamination problem

Acknowledgements

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